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MEDIA COMPOSER INCLUDING POINTER-BASED DISPLAY OF SEQENTIALLY STORED SAMPLES

Cross Reference to Related Applications

This application is a continuation of Ser. No. 09/489,330, January 21, 2000, which is a continuation of Ser. No. 08/873,577, June 12, 1997, Pat No. 6,018,337, which is a continuation of Ser. No. 08/045,646, April 9, 1993, which is a continuation-in-part of Ser. No. 07/866,829, Apr. 10, 1992, Pat. No. 5,355,450, all of which are herein incorporated by reference.

Field of the Invention

The invention relates to the display of sequentially stored samples under the control of a pointer, and more particularly, to the use of a mouse as a jog or shuttle control for computer-based video and audio composition.

Background of the Invention

It is known to provide on a media player, such as a video tape recorder, a jog and/or shuttle knob. A shuttle knob allows the operator of the media player to adjust the speed of the player in either a forward or reverse direction. A jog control allows the user to move in forward and reverse directions through the medium on a still

frame by frame basis. Examples of prior art jog and shuttle controls include levers, knobs, concentric knobs, and knobs that change function when pressed upon axially or when another switch is pressed.

A common system is a three-button system, in which the user places three of his or her fingers on three buttons. The outer two fingers control the forward and reverse shuttle operations, which are much like fast forward scan and rewind scan buttons on a video tape recorder, except that multiple presses on the outer buttons in shuttle mode result in proportional increases in shuttling speed. For example, three presses will cause shuttling to take place at triple the shuttling speed. The central button is a stop button, and when it is held down, the outer buttons act as forward and reverse jog controls.

In computer-based media composition systems, a visual representation of a shuttle or jog control may be displayed and manipulated with a mouse. For example, an image of a slider or a film strip may be presented to the user. The user may then click on the slider with the mouse and drag the slider to perform either shuttle or jog operations. For example, the Quantel Harry system, available from Quantel Systems, Inc. of England, uses this type of metaphor. Generally, however, these systems require the user to be watching the screen so that they may locate the mouse pointer in a proper position on the slider.

Summary of the Invention

In general, the invention features selecting samples for presentation on an output device, such as a display or speaker, from a sequence of stored media samples, such as audio or video information. Position information is received from a pointing device, such as a mouse, and translated into direction and magnitude information. A second sample is then retrieved based on this position and magnitude information. This method may be used to implement jog or shuttle controls for a media composer, which may be provided with simulated "inertia" for ease of use.

A media composer according to the invention has the advantage of convenience and efficiency for the user. The user may perform composition operations using the pointing device and, without removing his or her hand from the pointing device, move to the next location on the medium to be composed. The user may also do so without looking at a control screen at all; he or she need only look at the material to be composed. These capabilities are provided inexpensively in a commonly-available pointing device, which may already be a part of the user's composing system. Also, the added inertia in both jog and shuttle modes, and playback speed limit in shuttle mode may prevent the user from getting lost in the material to be composed.

Brief Description of the Drawings

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the accompanying drawings, which are incorporated herein by reference and in which:

FIG. 1 presents a media composing workstation portion of a media composing system according to the invention; and

FIG. 2 is a system block diagram of the media composing system of FIG. 1.

Description of the Preferred Embodiment

Referring to FIG. 1, an exemplary media composition workstation according to the invention includes a computer output system 12 and computer input system 14. The output system may include one or more computer monitors 16 and one or more speakers 18. The input device may include a keyboard 20 and a pointing device 22, such as a mouse with one or more buttons 32. The display presented to the user on the monitor may be divided into a window 24 for variable speed playback, on-screen scrub controls 26, a timeline display 28, and a timeline position indicator 30.

Referring to FIG. 2, a media composing system 40 according to the invention may also comprise a mouse/scrub control module 42, a player module 44, a timeline module 46, and storage 48. The mouse/scrub control module is connected to the keyboard via a

data path 50 and to the pointing device by another data path 52. The player module 44 is connected to the mouse/scrub control module via a further data path 54.

The player module is also connected to receive information from the storage 48 via a bus 56, which may comprise several data lines 64, 66, 68. These data lines may be dedicated to different synchronized media channels, such as video and audio channels. The bus 56 is further routed to the timeline module 46, which also receives data from the player module via a data path 58. The player module may provide information to the moving picture window 24 via a picture information path 60, and may provide synchronized sound information to the speaker via a sound information data path 62. The timeline module supplies information to the timeline display 28 via a timeline information path 70.

It is observed that the routing of data and information may differ from the block diagram in an actual implementation. For example, the moving picture window and timeline display may be displayed on the same monitor and therefore share a data line. The pointer data might also be routed through the keyboard on its way to the mouse/scrub module or the keyboard might not be needed at all. Furthermore, the invention herein is applicable to composition operations on sound alone, and therefore the displays may not be necessary. Alternatively, the operations may be performed on images alone,

making speakers unnecessary.

The pointing device 22 may be one of several general purpose pointing devices available for computers. It may be a mouse supporting one or more buttons 32, or it may be a trackball, a light pen, a digitizing pad, touch pad, touch screen or the like. These types of pointing devices are commonly used to position a cursor on a screen of a computer system, or to receive position dependent data, such as that generated in a manual digitizing operation.

A system according to the invention may be developed using a variety of types of computer systems. In one embodiment, an Apple Macintosh and the "C" computer language were used, but naturally the invention should not be read to be limited to this particular platform. The mouse/scrub control module, player module, and timeline module may be implemented in software and/or hardware and may or may not be contained within the computer system. A software package entitled "Avid Media Composer", available from Avid Technology, Inc. of Tewksbury, Massachusetts includes these features. The storage may include a high-speed, high capacity internal magnetic hard disk drive. For further information on computer-based media storage and playback of video and audio information, see Peters et al., "VIDEO AND AUDIO TRANSMISSION SYSTEM AND METHOD", U.S. patent No. 5,045,940, issued September 3, 1991, herein incorporated by reference.

Storage 48 contains one or more sequences of

image and/or sound samples, and may also contain a sequence of composition information, such as editing and special effect information. The images may be stored in compressed form, allowing more images to be stored in a given amount of space. The sequences of images and sound are generally related in time much like the tracks of a multiple track type recording. For example, the storage may provide multiple logical connections including one or more for picture information 64, one or more for sound information 66, and one or more for composition information 68.

Referring to FIGS. 1 and 2, in composing material, the user interacts with the workstation portion of the system 10. Composition operations may include editing operations, special effects generation, dubbing operations, or the like. The composition to be worked on is displayed in an outline format in the timeline display. This outline format may include waveforms for sound information, or a series of representative pictures for image information such as video or film sequences. If a user desires to perform a composing operation on a particular scene he, or she may move the pointer 34 on the screen using the mouse and click on the portion of the timeline which shows the representative scene indicating the location at which the edit is to be performed. This is a relatively rough operation as computer displays will generally only allow display of a relatively low

number of images on a timeline at a meaningful size.

Once the user has located a rough location for the edit using the timeline position indicator, he or she may perform more precise jog and shuttle operations. To do so, the operator may use the pointing device to click on the on-screen controls 26 or may press a key 21 on the keyboard 20. This operation puts the workstation in shuttle mode. In this mode, when the user moves the mouse to the left, the workstation begins moving through the stored sequence of images at a rate determined by the distance through which the user has moved the mouse. This corresponds to a reverse shuttle operation, which may analogized to scan rewinding a video tape at a variable rate, with the rate dependent on the mouse displacement. Conversely, moving the mouse to the right will cause the sequence of images to be moved through in a forward direction in a forward shuttle operation.

The system 40 performs this shuttle operation by first obtaining position information from the pointing device through the data path 52. This operation may be performed by directly accessing the hardware associated with the pointing device, or by retrieving a coordinate stored by the computer's operating system. This mouse position information is then translated by the mouse/scrub control module into direction and magnitude information, which is transferred to the player module.

The magnitude information may be represented by

the X-coordinate of the current position of the mouse subtracted from the X-coordinate of the position of the mouse when the mode was entered, with this difference being multiplied by a scaling constant. The sign of this difference may be used as the direction information. The value of the constant will determine how sensitive the shuttle operation will be.

The direction and magnitude information can be transformed in this operation into numerical values which can be directly applied to the player module as commands. The direction information represents the direction of playback for the player module, and the magnitude information represents the speed of playback. These relayed commands directly cause the player module to display the sequences of images and/or sounds on the display at the appropriate rate.

In the shuttle mode, the system limits the maximum forward or reverse speed to three-times the sound speed (the sound speed is the speed at which a video sequence is played where the sound is played at the proper speed). This speed limiting feature prevents the user from getting lost by moving the mouse at a high rate of speed, such as by accidentally knocking the mouse across the desk.

Furthermore, in shuttle mode, "inertia" is added to the operation of the control. Rather than supplying information about mouse position changes directly to the player, changes in mouse position are moderated over a short period. In one

embodiment this is done by responding to changes in mouse position by providing a smaller corresponding change in speed to the player module and gradually increasing that change in speed to the full change in speed indicated by the mouse. For example, if the user were to double the distance of the mouse from its starting position, the mouse scrub control module might convey a 50% increase to the player module, followed closely by a 75% increase, and then a 90% increase, and finally a 100% increase. It has been found that this inertia enhances the ease of use and efficiency of use of the apparatus.

In shuttle mode, the system also has a small threshold value below which no shuttle operation takes place. This prevents the player from playing back at extremely slow speeds which are of little use and are sometimes found to be uncomfortable to the user. Values on the order of a 1% threshold have been found to be satisfactory.

The user may also use a jog mode for the workstation. Jog mode is similarly controlled by the position of the mouse, but advances from still frame to still frame within the sequence of images, rather than adjusting the speed of playback of the images. In jog mode, the distance the mouse travels from its starting point relates to the offset within the sequence of frames between the current position and the position to be displayed.

To enter jog mode from shuttle mode, the user may simply press and hold the mouse button 32. This

stops the action in the display window and subsequent motion of the mouse will constitute jogging operations. Other methods for entering the jogging mode are possible, such as keyboard keys 21. Similarly, the user may exit the jog mode by one of these methods, or by double clicking on the mouse button 32. Releasing the mouse button while in jog mode will return the user to shuttle mode, and with the current mouse position as the starting position at zero play speed.

In the jog mode, the mouse scrub control module receives position information from the pointing device and translates it into a different kind of direction and magnitude information. The mouse scrub control module constantly monitors the mouse and performs velocity calculations based on the position information of the mouse over time. The resulting velocity information may be supplied directly to the player module, after it is adjusted by a constant. By making the speed of the player proportional to that of the mouse, the player module will track the mouse position.

Inertia may also be added to the jog operations in a manner similar to that disclosed above in connection with the shuttle mode. This is particularly useful in connection with sound information, as it makes sound playback more regular during a jog operation.

It is noted that the timeline moves during both jog and shuttle operation and that this provides

feedback to the user in these operations. This feedback enhances the ease of use of the workstation operations and prevents the user from getting lost. Also, the user or system designer may adjust the constants determining the sensitivity of the jog and shuttle controls and the inertia, threshold and maximum speeds in the shuttle mode. This allows the user or designer to customize the "feel" of the workstation.

While there have been shown and described what are at present considered the preferred embodiments of the present invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.